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Paste This in Your Hat

We desire to call attention to the members of the A. E. S. who anticipate attending the Annual Convention to be held in Milwaukee, June 30th, July 1st, 2nd and 3rd, that it may be possible for them to return at one-half railroad fare if attendance is large enough and the members, when purchasing their tickets, will ask for a certificate, so please don't fail to secure a certificate when buying your ticket to Milwaukee. We want at least two hundred and fifty.

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EDITORIAL

KEEP MOVING FORWARD

With this issue we end the official year 1923-24. The Milwaukee Convention will start things for the next year.

Reviewing the work of the Society for the year past we find many reasons for encouragement, as we see the Society making progress toward the goal it has set for itself, "To advance the science of electroplating." Knowledge is the accumulative experience of the race, therefore, the more we can accumulate of the experince of others the broader will become our knowledge.

The scheme for granting prize awards that goes into operation this year should stimulate the members to write up their experience or ideas, thus aid the Society to more perfectly realize its objective. To boast of past achievements is of little or no value; each year's work should be an improvement on the past year. Much that is considered new today may be out of date next year, and for this season we find no place to stop, to say we know enough or to feel satisfied with our present knowledge. We must do the work at hand with the best methods our present knowledge offers, but what of the future? We must keep our eyes open and ears to the ground that we may grasp the contributions of the future, because the future is sure to bring us better methods, more efficient solutions and equipment. So we need the "dreamer" who can see the enlarged field for usefulness that is open before us. Today we may say of a thing "It can't be done," only to learn in the near future that someone who didn't look at it in the same way we did, is actually doing it.

For instance, today the Society may believe it impossible to establish an electroplaters' institute, as suggested by our founder, Mr. C. H. Procter, yet in a few years this may be an accomplished fact.

Let each keep in the path of progress and enlarge the knowledge of our profession and our field of usefulness.

CONDUCTIVITY OF NICKEL SOLUTIONS

By L. D. Hammond

[1]L. D. Hammond—"Conductivity of Nickel Depositing Solutions" Trans. Am. Electrochem. Soc., Vol. 45, (preprint) April, 1924.

This investigation was conducted as a part of the general study of nickel deposition in progress at the Bureau of Standards. The conductivity of nickel solutions, such as are used in electroplating and electrotyping, is important because it may affect the power cost, the throwing power and the character of the deposits. The conductivities of nickel sulphate solutions containing such substances as are commonly added to nickel baths were therefore determined. The details of the methods used in the investigation have been described in a recently published article.[1] The results of interest to electroplaters may be summarized as follows:

To avoid confusion it is desirable to distinguish clearly between the following terms, viz., resistance, resistivity, conductance and conductivity. The **resistance** of any bath containing two electrodes is expressed in **ohms,** and (if we disregard polarization) it is equal to the applied voltage divided by the current in amperes. Thus, if when a potential of 3 volts is applied to a certain bath, a current of 300 amperes flows, the resistance of the bath is equal to 3/300=1/100 or 0.01 ohms.

The **resistivity** of the solution in the vessel is the resistance of a definite portion of that solution contained between two electrodes of a definite size and at a definite distance from each other. The customary unit of resistivity is that of a "centimeter cube" of solution having a resistance of one ohm between two electrodes each 1 cm square and 1 centimeter apart. This unit is called the ohm-centimeter, and the resistivities so expressed are often referred to as "ohms per centimeter cube." It is possible to express and

compare the resistivities in terms of the "inch cube," the resistivity of which is equal to 0.39 times that of the "centimeter cube." As, however, we are usually concerned with relative and not actual values, there is no advantage in converting the metric to the English units.

The **conducstance** is the reverse or reciprocal of resistance, and **conductivity** is the reciprocal resistivity. Thus, if the resistance of a certain bath is 0.01 ohm, its conductance is 100 "reciprocal ohms." Similarly, if the resistivity of a certain solution is 25 ohm-centimeters, its conductivity is 1/25 or 0.04 reciprocal ohm-centimeters.

In the usual determination of electrical conductivity it is customary to measure the resistance, in ohms, of a vessel or "cell" filled with the solution. The electrodes are of platinum, coated with spongy platinum or "platinum black,' and an' alternating current is used in order to eliminate the effects of "polarization," such as may be caused by changes in the concentration of the solution near the electrodes during electrolysis with a direct current. The resistivity of the solution is calculated from the resistance of the cell when filled with a solution of known resistivity.

The numerical results in this paper are given in terms of resistivity in ohm-centimeters. In considering these data it is important to remember that a decrease in resistivity corresponds to an increase in conductivity.

TABLE 1

Resistivity of nickel sulphate solutions at 25°C (77°F):

	Concentration of $NiSO_4 . 7H_2O$		Resistivity
N	g/L	oz/gal	ohm-cm
0.5	70	9	53.0
1	140	19	34.4
2	281	37	22.2
3	421	56	19.0
4	562	75	18.3

From Table 1 it may be seen that increasing the concentration of nickel sulphate from 9 to 37 oz/gal makes a decided increase in conductivity, but beyond that point the improvement is not sufficient to warrant the increased cost of stronger solutions and the consequently greater loss of material in the solution which adheres to the work.

TABLE 2

Resistivity of normal nickel sulphate solution (140 g/L or 19 oz/gal) containing added compounds at 25°C (77°F):

Added Compound Name	Formula	Concentration N	g/L	oz/gal	Resistivity ohm-cm
Sodium sulphate	Na_2SO_4	0.1	7	0.9	29.4
		0.2	14	1.9	26.2
		0.5	36	4.8	20.0
		1.0	71	9.5	15.0
Potassium sulphate	K_2SO_4	0.1	9	1.2	28.1
		0.2	17	2.3	24.2
Ammonium sulphate	$(NH_4)_2SO_4$	0.1	7	0.9	28.0
		0.2	13	1.7	24.0
		0.4	26	3.5	18.8
Magnesium sulphate	$MgSO_4 . 7H_2O$	0.1	12	1.6	31.5
		0.2	25	3.3	29.4
		0.5	62	8.3	25.3
		1.0	123	16.5	21.1
Sodium chloride	NaCl	0.1	6	0.8	27.0
		0.2	12	1.6	22.5
		0.5	29	3.9	15.4
		1.0	58	7.8	10.5
Ammonium chloride	NH_4Cl	0.1	5	6.7	26.0
		0.2	11	1.5	21.1
		0.4	21	2.8	15.3
Nickel chloride	$NiCl_2 . 6H_2O$	0.2	24	3.2	27.2
		0.5	59	7.9	20.5
Sodium fluoride	NaF	0.1	4	0.5	28.8
		0.2	8	1.1	25.5
		M			
Boric acid	H_3BO_3	0.1	6	0.8	33.9
		0.2	12	1.6	34.1
		0.5	31	4.1	35.0

[1]In the solutions containing nickel chloride the nickel sulphate concentration was correspondingly decreased so that the total nickel concentration was always normal, as in the other solutions.

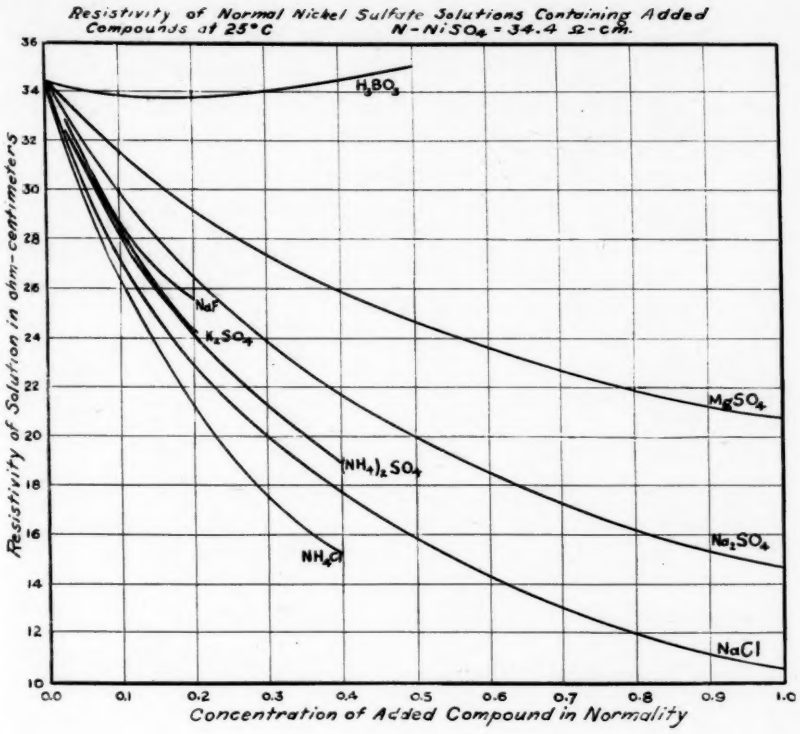

FIG. 1

From Table 2 and Fig. 11 it may be seen that the resistivity of normal nickel sulphate solution (34.4 ohm-cm) is decreased by the addition of each of the compounds listed except boric acid, which has a practically negligible effect. Of the four sulphates tested, equivalent additions of the magnesium sulphate have the least effect, and in small concentrations ammonium sulphate has the largest effect. The possible concentration of ammonium sulphate is, however, limited by the low solubility of the nickel ammonium sulphate $(NH_4)_2SO_4 . 6H_2O$ (the common "double nickel salt").

Similarly low concentrations of ammonium chloride produce a greater increase in conductivity than do equivalent amounts of sodium chloride. Owing to the limited solubili-

ty of the ammonium chloride in the nickel sulphate solution, a higher conductivity can be produced by the addition of sodium chloride than with any of the other salts tested. The indications are, however, that the ammonium chloride has a more beneficial effect upon the character of the deposit than has the sodium chloride.

TABLE 3

Resistivities of normal solutions at 25°C (77°F):

Name	Formula	Concentration g/L	Concentration oz/gal	Resistivity Ohm-cm
Hydrochloric acid	HCl	36.5	4.9	3.07
Sulphuric acid	H_2SO_4	49	6.6	4.8
Acetic acid	$HC_2H_3O_2$	60	8.0	670
Boric acid	H_3BO_3 (M)	62	8.3	70000
Potassium hydroxide	KOH	56	7.5	5.7
Potassium chloride	KCl	74.5	10.0	8.9
Potassium cyanide	KCN	65	8.7	8.2
Sodium hydroxide	$NaOH$	40	5.4	5.7
Sodium chloride	$NaCl$	58.5	7.8	11.6
Sodium fluoride	NaF	42	5.6	18.5
Sodium sulphate	Na_2SO_4	71	9.5	16.8
Sodium carbonate	Na_2CO_3	53	7.1	18.7
Sodium phosphate	$Na_2HPO_4 . 12H_2O$	119	16.0	31.5
Ammonium hydroxide	NH_4OH	35	4.7	970
Ammonium chloride	NH_4Cl	53.5	7.2	9.0
Ammonium sulphate	$(NH_4)_2SO_4$	61	8.2	12.9
Calcium chloride	$CaCl_2$	56	7.5	13.2
Magnesium sulphate	$MgSO_4 . 7H_2O$	123	16.5	29.9
Copper sulphate	$CuSO_4 . 5H_2O$	125	16.7	34.1
Zinc sulphate	$ZnSO_4 . 7H_2O$	144	19.3	32.1
Zinc chloride	$ZnCl_2$	68	9.1	13.4
Cadmium sulphate	$CdSO_4$	104	13.9	38.0
Cadmium chloride	$CdCl_2$	92	12.3	40.0
Ferrous chloride	$FeCl_2 . 4H_2O$	99	13.2	14.5
Ferrous sulphate	$FeSO_4 . 7H_2O$	139	18.6	31.6
Nickel sulphate	$NiSO_4 . 7H_2O$	140	18.8	34.4
Nickel chloride	$NiCl_2 . 6H_2O$	119	16.0	14.1
Cobalt sulphate	$CoSO_4 . 7H_2O$	141	18.9	34.1
Cobalt chloride	$CoCl_2 . 6H_2O$	119	16.0	14.5

In order to compare the resistivities of the nickel solutions with those of other solutions such as may be used in plating operations, Table 3 has been compiled. From this table it may be seen that in normal or chemically equivalent solutions, the strong acids and alkalis have the lowest resistivity or highest conductivity. The sulphates of the "heavy" metals, such as iron, nickel, cobalt and zinc, have relatively high resistivities, which can be reduced by the addition of better conducting salts, such as the chlorides and sulphates of sodium, potassium and ammonium. When, as in copper sulphate solutions, a high concentration of sulphuric acid is permissible, the conductivity may be thereby greatly increased. With nickel solutions, however, which must be kept nearly neutral, it is not practicable to increase the conductivity to approach that of the acid copper bath.

THE ELECTRO DEPOSITION OF NICKEL UPON HIGH CARBON OR OTHER STEELS TO GIVE THE MAXIMUM RUST-RESISTING SURFACE

By Charles H. Proctor

It is the aim of every manufacturer of ferrous metal products, at present, to give to his product the maximum of protection against rust and corrosion. The ravages of these two great atmospheric factors is too well known to require any explanation. In the production of electroplated products for automobiles or other products, the trade and the consumer demand that they shall obtain the best possible product for which they pay the price. Hence, this short article is written with the aim of giving data covering modern plating solutions and methods that will help to bring nickel-plated steel products to a point where they can meet the demands made upon them.

The polishing of the articles to be finally nickel plated will not be dealt with; every manufacturer of steel-plated products has his own ideas about polishing of the metal surfaces. Machinery is now playing a very important part in the polishing of flat steel surfaces, eliminating manual labor to a great extent.

It should be the aim of the manufacturer, however, to produce an even, smooth, polished surface that shall show no lines or cross lines, that will create a deflection of the

light in the finished product which has a tendency to show up a gray finish with an unequally plated surface when exposed to the rays of light.

The cleansing of the steel is a problem, although not a serious one, but the final success of any electro deposited metal depends upon a chemically clean basic surface. It should be the aim of every operator in the plating department to produce this most important result upon his product.

The cleansing may be accomplished with commercial cleaners of various types and composition. The methods of cleansing may be by the still or electro method. The latter is preferred whenever possible, because the use of acid pickles following the electro cleansing can be avoided.

It is only necessary to thoroughly wash the cleansed surface in cold, clean water, then immerse the product in a 10 to 20% solution of sodium cyanide heated to 120° Fahrenheit. With a rewashing of the surface of the articles in water it is then ready for the first plating operation in the process of producing the maximum of a rust-proof nickel-plated surface.

If acid pickles, however, must be used, a pickle consisting of 25% sulphuric acid, 10% hydrochloric acid and 65 parts water gives excellent results at 110° Fahrenheit. These proportions of acids may be increased as desired.

Following the final cleansing and washing operations the articles are now ready for the nickel strike solution. This solution consists of the following chemical proportions:

Water	1 gallon
Single nickel salts	32 ozs.
Nickel chloride	4 ozs.
Boracic acid	3 ozs.

Anodes, 99-100% electrolytic; temperature, 110° Fahrenheit; voltage, 5 to 6; amperage, 50 per square foot surface area. Time of strike deposit from 5 to 8 minutes.

The solution should be air agitated from the bottom of the tank; the air deflection should be upward and directly toward the cathode. It should be the aim in regulating the current to avoid burning or over-nickeling upon any portion of the article.

After the nickel strike has been applied the articles should be removed and thoroughly washed in cold water. They are now ready for immediate copper plating. The following formula has given excellent results in copper-plating steel products:

Copper Plating Formula:

Water	1 gallon
Sodium cyanide	7½ ozs.
Copper cyanide	6 ozs.
Soda ash 58%	2/3 ozs.
Powdered borax	2/3 ozs.
Hyposulphite soda	10 grains

Anodes, 99% copper; 1% tin (cast); temperature, 110-120° Fahrenheit; voltage, 5; amperage, 25; minimum time of plating, 30 minutes.

Following the copper-plating operations and thorough washing in cold and boiling hot waters, the copper-plated surface is now ready for polishing to obtain the lustre desired for the final nickel deposit.

The lustre should be uniform and free from shadows. After polishing the copper-plated surface should be carefully cleansed. In the cleansing of polished-plated surfaces a mild cleaner should always be used. The following formula has given excellent results:

Cleansing Solution:

Water	1 gallon
Trisodium phosphate	4 ozs.
Soda ash 58%	4 ozs.

Temperature, 180° Fahrenheit.

Following the cleansing operation and thorough washing in cold water the cleansed copper-plated surface should be immersed in a dilute sodium cyanide solution to remove any stains or superficial oxides remaining upon the cleansed copper surface. A solution consisting of 75 to 90 parts water and 25 parts to 10 parts sodium cyanide will be sufficiently strong for the purpose.

Following a rewashing in cold water the articles are now ready for the final nickel plating.

Regular Nickel-Plating Solution:

The formula given for the strike nickel solution produces excellent results in the final nickel-plated deposits.

The following formula, however, will give an even malleable nickel-plated surface from from hydrogen:

Water	1 gallon
Single nickel salts	28 ozs.
Nickel chloride	4 ozs.
Boracic acid	3 ozs.

Anodes electrolytic nickel. Temperature of solution, 110° Fahrenheit at 5 to 6 volts; amperage, 25; minimum time of plating, 20 to 30 minutes, which may be decreased by increasing in amerage. Amperages up to 50 amperes may be used per S. F. A. if the nickel sulphate content is increased to 40 ounces per gallon.

Following the final nickel plating operations and thorough washing in cold and boiling water, the articles are ready for the final finishing. It should be the aim to produce an even lustre finish upon the surface.

The usual color buffing operations are too well known to require any repetition of the methods.

A total deposit of one and a half thousandths of an inch from the triple solution upon a steel-plated surface should resist a maximum of not less than 50 hours under the salt spray test.

A deposit of two one thousandths, however, should be a standard deposit.

If the operations are carefully adhered to as outlined it is the belief of the author that the maximum in rust-resisting nickel-plated steel surfaces will result, which can be considered as a standard product.

ORNAMENTAL IRON AND BRONZE

By J. S. Cairns, Toronto Branch

In reading this paper, I would like to confine myself to the polishers and platers intelligence, not only as a first class mechanic, having knowledge only for a first class square edge job, but having the gift for the love of art and knowing art when he sees it. Some platers are very clever at making up solutions and have a good knowledge of chemistry, he is also an electrician, besides knowing how to run a steam boiler and the complicated parts of the automatic steam trap, is it still possible for him to be a mechani-

cal polisher, to have a love for art, to know how to finish a piece of work on the polishing lathe and to do the actual finishing himself by depositing a coating of metal and colouring that same piece of work to a sample. If so, then let us give him the credit of being a metal plater.

Now, let us look into the oramental iron and bronz line of plating. There are quite a number of platers who look on this line as being of very little importance and their objection to it is, that it is a thankless, dirty job. but I shall also say there is more art in the ornamental iron and bronze line than all the other lines of the plating profession. The ornamental iron line is not run on a production system, as each job is a special in itself, calling for blue prints and drawings for that one particular job the company has estimated a price before receiving the work, it was customary for me to go over the drawing with the heads of the firm, so as to give them an idea as to the cost of polishing and plating, irrespective of any color the architect may desire. Sometimes the architect will hold back the color or the finish for two or three months, until the fitters have a certain amount of work cut out for the polishers, then you have to chase him up to see what color or what finish he wants and also a sample, if any. It would be ridiculous and foolish to start polishing the work if you didn't know what finish the architect wanted, because a hundred chances to one he will want something that somebody else hasn't got. You then work for the interest of the architect, as far as it lies in your power to please him with the finish. He may show you a sample, but, he may not want it the same, but just a little darker or lighter and sometimes he changes his mind and gives the plater a whole lot of trouble by suggesting a green background on the mouldings, then you have to watch the fitters in the workshop, that they do not make the panels larger than your tanks; that is, where possible. Sometimes a panel can be made in two pieces and look just as well, but I have seen where they could not help me in the least, and you have to plate these panels the best way you know how. For instance, it may be a cast iron cornice for an elevator enclosure and the corner pieces are mitred. Once you take those corner pieces away from the mitering you cannot replace them without filling something

about them and in order to save plating them twice over, you might as well plate the whole thing in one piece, but before plating you must have the work polished, which is generally done in pieces, sometimes there is quite a lot of work done on those pieces before coming to the polishing room and are in a semi-ready state. If the polisher does not know his business and happens to spoil any of those semi-ready pieces, it is quite a loss to the firm. Now I want to state right here, if I didn't have full control over the foreman polisher in an oramental iron shop I would not accept the position as plater. For instance, a glazed piece of cast iron may be all right for nickel and brass deposits that have to be finished on the color buff, but it would not do as well as being a useless expense if it was to be colored a dark statuary finish. Of course, it could be done, but then it would be foolish. You must give your work the emery finish according to the finish of the sample. The plater knows the emery finish he requires, the foreman polisher doesn't know the emery finish that is wanted, but he is good and sure of the finish platers is going to get. Every plater should know how to polish the work he is plating. I am not advocating for him to do it, but it would be a great benefit to him if he knew. Take for instance, we have a piece of cast iron, a piece of rolled iron and a piece of sheet steel and we give them to three different polishers, their chief ambition is to take out the emery marks with one wheel, what he put in with the preceding one. One man may glaze his piece, another may use the tampico brush or he may finish with 150 dry with the upward stroke. Another may use a buff, just because he thought of the buff first. Then along with some other pieces which have been finished on the greese wheel, they all combine to make one panel, which is often the case. You then can imagine what kind of a time the plater is going to have if that panel has to be colored and made uniform to a dull brass and colored sample. This sample may have gone through the sand blast and although the architect may not demand a sand blast finish on the work, you have contracted for, he will still hold you down to the shade of the sample. So you see it is necessary to have your work done with an emery uniform finish to allow the plater to produce the work as near

the sample as possible. In hiring a polisher for this class of work, it is a wise policy to pick out men who are mechanically inclined and who have at least a look of intelligence, rather than those who claim to do three days' work in one. Bear with them for a while and train them to your ideas, and after you get a few good men, try and keep them by finding work for them in another department when there is nothing for them in the polishing room; such as drilling or rough grinding. It is wonderful what a good polisher can do on a solid carborundum wheel. Polishers as a rule are a tough lot and I think they would have to be. My heart goes out to them in sympathy, they swallow brass and iron dust, emery glue and cotton and at the end of the day they are deprived of a good glass of ale in this Christian part of the country.

PLATING ROOM

After the work is finished in the fitting department, it is sent to the plating room generally covered with machine oil and in certain seasons of the year, when the fitters hands are perspiring you can see finger prints and hand marks of rust all over the work. The plater cannot plate the work without first scouring and erasing the rust spots. You then cover your work with cyanide water, otherwise it would be covered with a rusty scum before you could get the work under the surface of the plating solution in the tank. Now I want to lay great stress on what I call preheating the article before the commencing of the electro deposition. As an illustration, let us take some of the extra large pieces, such as cornices and newel posts or in plainer words, upright corner cast iron parts for an elevator enclosure. Some of these pieces are very heavy, weighing from 400 to 900 lbs. You will now understand why I advocate covering the work with cyanide water before putting into the tank. Before lowering this large piece down into the solution, pull the reostat over to zero, then lower away on your chain blocks and let your work hang in the solution for at least five minutes. It will almost take five minutes anyway before you are able to wire this piece to the cathode rod. Keep the heat going through the solution, because by introducing this large cold piece it is liable to

lower the temperature. Of course, there is a certain amount of heat generated by the current but will not be sufficient to make up the loss caused by this large cold piece, always use a good thermometer, your finger is not reliable. By following this course you are plating a warm solution against a cold surface. By following the directions of my theory, you will find that your troubles of blistering will be almost nil. I gave those pieces all the current of a ten volt dynamo through the reostat for fully four hours. I kept tab on the deposition by hanging a small piece of cast iron wired to the large piece. I changed the solution from brass to bronze according to the finish that was desired. I used the plastic carbonates. This tank was 14 feet long, 2 feet broad and 7 feet deep. I kept the solution low in cyanide and changed the annodes three times during the deposition, thereby getting a uniform deposit that enabled me to get down to the desired shade of the sample. If the color was to be a light statuary finish, I would use the brass solution and color with the golden antim of antimony. If the shade was to be a dark one, I would use the bronze solution and color with the liver of sulphur. These heavy pieces are colored by lying on wooden tressels and you have to be particular if your work is to be a uniform color on two, three or four sides. It is an easy matter to color the first side, but when you turn it over the coloring solution is liable to run back and spoil what you had already done. Always finish the face of the job last and by adhering to that well known slogan of "patience and perserverance" the reward of your labor will be pleasing to the eye.

Varied and rather comical stories are told by ornamental iron platers in their dealings with crank architects. I have had work condemned at ten o'clock in the morning and by moving it to the other side of the lacquer room it was passed as O. K. in the afternoon. Daylight is the controling factor of any ornamental colored job, when you have your work displayed around the lacquer room just before shipping away have a good look at it, because you will never see it like that again. You have the erecting gang to contend with and I never knew these men to have any consideration for the plater. The work you have just finished may be a counterraling for the banking room on

the first floor of a large building, or it may be an elevator enclosure for the corridor of a building, facing the north with daylight coming in from the south at the back of the building. The real daylight coming in from the north may only penetrate as far as ten feet from the door and you will never see your counter-railing with the same uniform color that you saw before it left the lacquer room with all those disadvantages the architect will still make a howl if your work does not come up to the uniform color of his expectation. I have travelled from Montreal to the Rosenthal Building in Ottawa purposely to clean off a few hand marks that were left by the erectors; when I got there, I found the job spotted all over with some kind of a lime white wash, so in order that our firm may receive their last and final check for the work, I had to stay there until the architect gave his O. K. You may not be interested in this part of my paper, but I just want to show you that the platers' troubles are not over when the work is taken from the lacquer room, and if the architect does give you his final O. K. he will do so with a grumble.

A TREATISE UPON THE ELECTROPLATING OF ALUMINUM

By C. H. Proctor

The difficulty that arises in the electroplating of aluminum is primarily due to the rapidity of the oxidation of the aluminum surface which prevents the adhesion of the deposited metal.

Especially is this true when the surface is in the moist condition that results from the cleansing operations previous to the deposition.

Therefore it is necessary following the cleansing operations to render the aluminum surface passive while still moist before deposition of the metal under usual methods of electroplating.

Iron and cadmium have been found to give the best and most simple results in application to the aluminum surface to produce the passive state. Ledin in his description of "Nickel Plating on Aluminum," some experiments on dip solutions and their results (Metal Industry, Volume 20, 1922), advocates from his final conclusions the use of an

immersion of the aluminum articles following the usual polishing and alkaline cleansing operations, with the resulting washings in clean cold water.

1st. In an undiluted solution of commercial hydrochloric acid, then wash quickly in cold water.

2nd. Follow by an immersion in a dip solution prepared as follows:

Water	1 gallon
Hydrochloric acid	1 qt. (32 ozs.)
Cadmium chloride	3 ozs.

Following the immersion in the undiluted hydrochloric acid solution the articles are then transferred direct into solution No. 2 for 15 seconds, washed in water as quickly as possible and nickel plated direct in any standard nickel-plating solution.

The current conditions, voltage and amperage, should be equal to the current used for normal cold solutions—voltage, 3 to 4; amperage, 5 to 10 per S. F.

Ledin advocates the following formula for a dip solution when the immersion of the aluminum articles in undiluted hydrochloric acid is to be avoided:

No. 3:

Water	1 gallon
Hydrochloric acid	1 qt. (32 ozs.)
Cadmium chloride	3 ozs.
Ammonium fluoride	¾ ozs.

The manipulations previous to immersion in No. 3 should be as outlined. He gives the following formula for nickel-plating solution:

No. 4:

Water	1 gallon
Single nickel salts	8 ounces
Sodium citrate	4 ounces

Current densities as outlined.

The author, however, prefers a solution that has been given out quite frequently the past few years for the nickel plating of die castings (zinc aluminum alloy):

No. 5:

Water	1 gallon
Double nickel salts	8 ounces
Sodium citrate	4 ounces
Sodium chloride	3 ounces

The value of solution No. 5 lies in its low internal resistance and high throwing power.

The author appreciates the work of Ledin upon the subject of nickel plating aluminum, however. During the great World War he was called upon for assistance in overcoming the extreme difficulties then experienced in nickel plating hot water bottles made from sheet aluminum for the Army Department and advocated the use of a mixture of sulphuric and nitric acids and chloride of iron to produce a passive condition upon the aluminum surface and at the same time reduce oxidation. The formula was as follows:

No. 6:

Sulphuric acid 66°	½ gallon
Nitric acid 38°	½ gallon
Chloride of iron	1 oz.

The iron salt should be previously dissolved in a small amount of warm water before adding to the mixed sulphuric and nitric acids.

The methods of manipulation of the articles should be as previously outlined, the immersion of the aluminum articles in No. 6 should be from ten to fifteen seconds, followed by rapid rinsing in cold water and then the articles should be plated direct at a fairly high amperage until well covered with nickel. The current can then be returned to normal.

A different procedure must be followed in electroplating aluminum with gold, silver, copper, bronze or brass. However, up to the point of immersion in the acid dips the manipulations should be closely adhered to. Dilute acid solutions such as nickel solutions; do not reduce the film of iron deposited upon the aluminum surface after treatment in the acid passive dips. Cyanide solutions, however, do unless great care is used in applying the negative current to the articles immediately upon entering the cyanide solution of whatever type.

It has been found advisable as an extra precaution in copper, bronze or brass-plating aluminum to apply a thin deposit of zinc to the aluminum surface. The alkaline zinc solutions reduces the oxidation of the aluminum surface under the current application, and at the same time deposits a thin coat of zinc, which gives an excellent basis for

any deposit that can be obtained through the aid of sodium cyanide solutions. The author has frequently mentioned this procedure in the Metal Industry in volume 20, 1922, page No. 431, "Gold Plating on Aluminum." He prescribes the following formulas for zinc, brass, copper and gold plating:

No. 7, Zinc Solution:

Water	1 gallon
Sodium cyanide 96-98%	4 ounces
Zinc cyanide	4 ounces
Caustic soda	2 ounces
Soda ash	2 ounces
Aqua ammonia 26°	1 ounce.

Temp., 110-120° Fah.; Voltage, 4 to 5, anode surface 50% Sheet steel, 50% Pure zinc. It is not necessary to zinc plate the aluminum articles more than two or three minutes, they can then be transferred either direct, after draining thoroughly, to the copper or brass solution or first washed quickly in cold water.

No. 8, Copper Solution:

Water	1 gallon
Sodium cyanide	4¾ ozs.
Copper cyanide 96-98%	4 ozs.
Bicarbonate of soda	1 oz.
Bisulphite of soda	½ oz.
Hyposulphite of soda	5 grains

Temp., 110°F.; Voltage, 4 to 5. Anodes Cast Copper.

No. 9, Brass Solution:

Water	1 gallon
Sodium cyanide 96-98%	5½ ozs.
Copper cyanide	3 ozs.
Zinc cyanide	1 oz.
Bicarbonate of soda	1 oz.
Ammonium chloride	½ oz.

Temp., 80° F; voltage, 4-5; anodes, cast brass mixture, 80% copper; 20% pure zinc.

No. 10, Silver Solution (minimum basis):

Water	1 gallon
Sodium cyanide, 96-98%	4 to 5 ozs.
Silver cyanide	3 ozs.
Potassium carbonate	1 oz.
Ammonium chloride	1-3 oz.

Temp., normal; voltage, 1 to 2; anodes pure sheet silver. In silver plating aluminum it is advisable to follow the zinc deposit with a copper deposit, then lightly amalgamate with a mercury dip, just so the copper-plated surface is turned to a pinkish white. I have found this method to give the best results. When the zinc surface is plated with silver direct then after some time the silver-plated surface will develop minute blisters unless unusual care is used in the preparation of the aluminum surface.

No. 11, Gold Solution:

Water	1 gallon
Sodium cyanide	½ to ¾ ozs.
Gold cyanide	½ oz.
Phosphate of soda	¼ oz.
Bisulphite of soda	¼ oz.

Temperature, 120-140° F.; voltage, 2½ to 3 volts; anodes, fine gold, 22-24 Kt., or platinum, or 18 Kt. gold, as desired.

It is always advisable to brass plate or copper plate the zinc-coated aluminum surface before gold plating. The necessary scratch brushing of the brass plate or copper plate should be applied before gold plating to give the desired lustre.

Aluminum radio ear phones, gold plated upon aluminum more than three years ago by methods outlined, are still in as good a condition as when gold plated.

The application of the methods outlined in the electroplating aluminum should prove successful if carefully adhered to.

GET THIS, FELLOWS

The Chicago Branch has arranged to have a special coach or two put on the Pioneer Limited of the Milwaukee and St. Paul R. R., 6:30 standard time, June 29, so that if some of the visiting delegates and guests arrive in Chicago in the day and look around a bit they can arrange to get this train and feel that they will find friends upon this train.

TEN YEARS AS SECRETARY AND TREASURER OF THE PHILADELPHIA BRANCH, A. E. S.

(June 1, 1914, to June 1, 1924)

About the year 1890, Mr. Charles H. Proctor of Connecticut, and in charge of the plating department of the Ansonia Brass and Copper Company, conceived the plan of organizing a society of foremen platers, with the idea in mind of putting the plating industry on a higher plane generally.

In May, 1907, at the Second Regiment Armory of Philadelphia, upon the occasion of the organization of the American Brass Founders' Association, now the American Institute of Metals, after reading his paper on the "Electrodeposition of Brass," Mr. Proctor first made public his idea and suggested that a society of platers be organized.

Through the columns of the Metal Industry he appealed to the platers to support him. These appeals resulted in financial and moral support, and after several preliminary meetings in New York city, the organization known as the National Electroplaters' Society of the United States and Canada, was effected at the Hotel Chelsea, New York, March 6, 1909, and in June, 1909, it was granted a charter by the State of New York.

Branches were organized in rapid succession, the first being the Philadelphia Branch, in 1910, which was formed through a call to the foremen platers of Philadelphia and vicinity to meet at Dooner's Hotel. Sixteen foremen platers answered the call. Mr. F. C. Clements of Philadelphia, a member of the New York Branch, through whose instrumentality the call was issued, explained the object of the meeting and introduced Mr. Charles Proctor, who gave an interesting outline of his ideas and the benefits to be derived from such a society.

Mr. Proctor's address was received with much enthusiasm and the following foremen platers signified their intention of forming a Philadelphia Branch: F. C. Clements, James Moore, F. W. Buehler, H. Hermans, J. L. Dinan, R. Schofield, A. Keiser, A. Sartorie, J. Wilkinson, W. Buckley, C. Bailer, A. B. Wells, P. Uhl, A. Heck.

The first regular meeting was held September 31, 1910, in the Hartford Sterling Company's building, Fifth and Arch streets, and the following officers were elected: Pres-

ident, F. C. Clements; vice-president, James Moore; recording secretary, J. L. Dinan; secretary and treasurer, A. Keiser; trustees, H. Hermans, A. B. Wells, A. Heck, J. Wilkinson and W. Buckley.

During the following years these members served as presiding officers of the branch:

F. C. Clements 1910-1913
A. B. Wells 1913-1914
J. L. Dinan 1914-1915
S. Barr 1915-1916
W. J. Bell 1916-1917
O. W. Mott 1917-1920
D. A. Metz 1920-1921
G. Gehling 1921-

At the convention held in New York city, February, 1913, the name of the society was changed to the American Electroplaters' Society. During the first few years open meetings and social affairs were held, at which papers were read and topics of interest to the plater were discussed. These affairs were generally well attended, with the result that several applications for membership were presentd.

The meetings of the branch were held in Dooner's Hotel up until April, 1914, after which, through the efforts of S. D. Benoliel, we were given the privilege of holding our meetings in the University of Pennsylvania. This was quite an honor, and was much appreciated by the members, and Provost E. F. Smith and Dr. Lukens of the university, being honorary members of the branch, gave freely of their knowledge of chemistry to the members at different times.

Philadelphia Branch has always been represented at the various conventions held in Dayton, Cleveland, St. Louis, Detroit, Rochester, Indianapolis, Cincinnati and Providence. At the Indianapolis Convention the branch was honored in the election of Philip Uhl as Supreme President, in which capacity he served at the Cincinnati Convention in 1922.

Philadelphia also had the honor of being hosts to the Seventh Annual Convention of the society July 1, 2 and 3, 1919, in the Bellevue-Stratford Hotel. The convention was called to order by National President Walter Fraine of Dayton Branch; the address of welcome to the city was

given by E. J. Cattel, representing the Mayor, and the opening address by O. W. Mott, President of the Philadelphia Branch. Addresses were also made by Provost E. F. Smith, W. C. Gold, S. D. Benoliel, Charles Proctor and others on various subjects. Durin gthe sessions there was an attendance of 300, including a number of ladies, who were royally entertained in viewing the city, a boat ride on the Delaware River, and an automobile ride to Valley Forge. The convention was brought to a close with an elaborate banquet in the ballroom of the hotel. Much praise was given to the committees for the untiring efforts for the success of the convention, which was also manifested by the number of congratulatory letters received by the branch.

During the following year the branch continued growing rapidly and the members showed a desire to benefit from each other's knowledge and experience, as evidenced by the large delegations that attended the annual banquets of other branches and taking part in the educational sessions in reading papers and discussing the problems presented.

On October 23, 1920, fifteen members journeyed to the city of Reading to attend an open meeting arranged by this branch, with the object of forming a branch of the society. The meeting was a great success and was addressed by Dr. Lukens of Philadelphia Branch and Dr. Taylor of New York Branch. Supreme Secretary John E. Sterling also spoke on the advantage of being a member of the society. After his address the Reading Branch was organized with eleven charter members, who elected Levi P. Rathman as presiding officer.

On March 21, 1924, Dr. Blum of the Bureau of Standards, Washington, addressed an open meeting of the branch at the University of Philadelphia on the work done by the bureau in the research of the electro-deposition of nickel, etc. The talk was interestingly illustrated with lantern slides and practical demonstrations, and was enjoyed by the large number present.

At the March, 1924, meeting, Mr. A. K. Graham, instructor at the University of Pennsylvania, began a series of lectures on the fundamental theory of chemistry, these

lectures to continue until further notice. They are proving very helpful, as each talk contains a fund of valuable information for the plater, and much credit is due President Gehling and Dr. Lukens for securing Mr. Graham for these lectures.

In closing let me quote the great American, Theodore Roosevelt, who said: "Every man owes some of his time to the upbuilding of the profession to which he belongs." I will add that we must put something more into our profession than we take out if we want to become a factor in that profession, and that, I am sure, is the endeavor of every member of the American Electroplaters' Society.

BRANCH NEWS

Philadelphia Branch

Regular monthly meeting of Philadelphia Branch was held June 6th, with the President, George Gehling, in the chair and a good attendance.

One application was received. The application of A. Hirsch and C. Hessler were held over until the August meeting.

We regret to having received the resignation of A. Clabaugh who is going on the retired list after 32 years service with the Penns. R R.

The proposed ammendments were thoroughly discussed and the delegates to the convention were instructed to use their own judgment.

A. R. Graham gave the fourth of his lecture and the talk was on weights and valance.

The Secretary, on the occasion of his tenth anniversary as Secretary and Treasurer of the branch, gave a review of the birth and work of the banch during these years and was given a rising vote of thanks for the faithful service and his untiring efforts in the interest of the Society. There will be no meeting in July.

Grand Rapids Branch

Grand Rapids Branch held its last regular meeting May 14, 1924 and it was well attended. Election of Officers was held and the following members were elected for the coming year: President, Mr. Thomas Oates; Vice President, Mr. Axel Rickson; Secretary-Treasurer, Mr. John Raven; Librarian, Mr. Walter Allen; Board of Managers, Mr. Van Dyke, Mr. Charles O. Werft and Mr. J. C. Miller. A large delegation to the Milwaukee Convention is expected from this Branch.

DEATHS

Al. Parsons of Waterbury Branch.

H. S. Brockway of Detroit Branch.

Indianapolis Branch

Saturday, June 7, was a banner day for Indianapolis Branch. The meeting and smoker was attended by two supreme officers, F. J. Hanlon, Supreme Secretary-Treasurer, and E. J. Musick, First Vice-President, and by visitors from other branches—six from Chicago—all of them well known to the members of the A. E. S.; Dad Liscomb, E. Lamoureaux, R. J. Hazucha, Bill Bott, Jim Emmett and John Obberender, and I believe they were well repaid for their visit.

The meeting was attended by about 30 members of the society and many of the boys had some mighty fine things to say, and it was very interesting, but Indianapolis Branch had Prof. Moore of the Technical High School as the man of the evening and he spoke upon the Ionization topic, with blackboard illustrations that were a revelation to the men who heard his discourse and along just another line than which we have angled upon this subject before, and it is a sure thing that if Indianapolis Branch members do not avail themselves of more of this gentleman's generosity along these lines they are losing one best bet, and I feel sure that Prof. Moore would be glad to show them many more things along this line, and Mr. Hofman of Indianapolis Branch is to be complimented for the introduction of Prof. Moore to our society, and we wish that Indianapolis could bring the gentleman to Milwaukee for the convention.

The visitors to this meeting had a lot to say about the genuine Southern hospitality of the members of the Indianapolis Branch. They got food for both the physical and intellectual man.

Detroit Branch

Regular meeting, held Friday, June 6, with a large attendance, B. E. Miller presiding. Minutes of previous meeting read and approved. A large number of communications were read and action taken where necessary. No applications for membership were received.

A letter from Detroit Convention Bureau, requesting that 1925 convention of A. E. S. be held in Detroit, was received, but owing to the fact that Detroit will support Montreal's appeal for convention, the invitation was respectfully declined. Detroit is not in favor of reducing per capita tax at present, owing to the deficit each year with present rate.

A picnic committee, composed of Messrs. Wagner, Tompkins and Fritz, was appointed to make arrangements to hold a basket picnic in near future. Under good of order, J. H. Flanagan exhibited samples of 125 layers each of nickel and copper, alternately, used by Edison in making pure flake nickel for storage batteries. This was very interesting.

Detroit will hold their regular meeting the 2nd Friday in July, in order to hear the report of the convention delegates. Bills amounting to $52.80 were paid. Meeting adjourned at 10:30 p. m.

Hartford-Connecticut Valley Branch

Hartford-Connecticut Valley Branch held its annual meeting on May 26, at 747 Main street, Hartford.

The election of officers for the coming year took place, with results as follows: President, Tennant Elwin; vice-president, W. J. R. Kennedy; secretary-treasurer, James A. Bagshaw; librarian, H. R. MacFayden; board of managers, Charles E. Dunn, H. M. Roberts, E. N. Miller; delegates to annual convention, W. J. R. Kennedy, G. B. Hogaboom, G. E. Vibberts.

It was unanimously voted that delegates from this branch to the Milwaukee convention favor the amendment to the constitution proposed by Detroit Branch, which would create a sustaining membership in the society.

Mr. Hogaboom gave an account of the April meeting of the Electro-Chemical Society, giving an outline of the papers read and the discussion on each topic.

Hartford-Connecticut Valley Branch has become affiliated with the Hartford Engineers' Club, and beginning in June will hold its meetings in the Engineers' Club rooms on Haynes street, Hartford. This organization consists of a group of about a dozen technical societies, such as the Society of Heat Treaters, the A. S. M. E. and others. This branch will benefit greatly by association with other societies whose aims are similar to our own.

Toronto Branch

Personally we have yet to be convinced that a poor attendance at a branch meeting on election night is a credit to any branch. But nevertheless it will happen and it did happen, but those who were loyal were equal to the occasion and re-elected all the officers of 1923 to continue through 1924, one trustee excepted. Now, if the absentees have a kick it is their own fault. We discussed P. C. tax reduction, sustaining membership, cold electric cleaners, dry cleaners, nickel strips, and why nickeled cold water taps tarnished more readily than hot water taps; also how gauge dials were finished in silver with black figures, and a host of other things. W. S. Barrows was elected delegate to Milwaukee convention, with J. S. Cairns as alternate. We would appreciate any suggestions from other branches as to a good plan for increasing personal interest of members in A. E. S. activities; also how to get the outsider inside. Tell us so we may try it out.

Cleveland Branch

The Cleveland Branch of the A. E. S. met for the regular May business meeting at Hotel Winton. The meeting was called to order at 8 p. m. by President H. J. Ter Doest. The minutes of the previous meeting was read and approved as read. The Detroit amendment, and also the St. Louis amendment, was bitterly fought, with the result that we resolved that the Cleveland Branch is opposed to the sustaining membership, as it is not benefical to the body of the A. E. S. as present con-

stituted, therefore we instructed our delegates to vote against it at the convention. We believe the A. E. S. is for American electroplaters. The officers for the new year were elected.

St. Louis Branch

At our regular meeting, held on May 6, several communications were read, among them the proposed amendment regarding sustaining membership from Detroit Branch. After this was considered a substitute for that amendment was offered and unanimously adopted and secretary instructed to send copies to all branch secretaries for consideration at the meetings. If the time has come for this question it should be given much thought, as it may have a reaction on present membership.

The following officers were elected to serve next fiscal year: President, F. Menniges; vice-president, G. Powitzky; librarian, F. Horath; secretary and treasurer, H. H. Williams; board of managers, E. J. Musick, F. Ferrio and C. T. McGinley; delegates to convention, E. J. Musick, H. H. Williams, E. W. Heil; alternates, F. Menniges, C. T. McGinley, F. Horath.

Booster committee reported having arranged for a special car to accommodate our members and friends to Milwaukee convention. It will be no fault of Ed. Musick's if every member does not attend.

On May 15 a special meeting was held at American Annex, at which Dr. T. R. Ball of Washington University gave us a very instructive talk on "Indicators" for acidity control in nickel solutions. The exhibit demonstrated a simple way for any plater to follow.

After the lecture a fine lunch was served and a general social time had. This meeting was held under arrangement of Convention Booster E. J. Musick and "Speed-Up" Richards, while "Expert" Robins presided.

APPLICATIONS FOR MEMBERSHIP

Toronto Branch

John Walker, Active .....27 Earlscourt Ave., Toronto

Philadelphia Branch

J. Marlin Burd, Active .....525 Kelker St., Philadelphia, Pa.

Waterbury Branch

Fred Swalwell...Thomaston, Conn., employed by Seth Thomas Clock Co.

ELECTED TO MEMBERSHIP

Dayton Branch

Harry Wright, Active .....213 Shaw Ave., Dayton, O.
John S. Perry, Active .....R. D. No. 7, Dayton, O.

Detroit Branch

Harry Webb .....c|o Joseph N. Smith Co., Detroit, Mich.
R. L. Sheppard .....3157 Lakewood Blvd., Detroit, Mich.

Waterbury Branch

Fred Parker, Active .....279 N. Main St., Scrithington, Conn.